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SYSTEMS ANALYSIS AND THE DYNAMICS OF MANPOWER

by

Carson K. Eoyang

June 1975

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Monterey, California

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A Behavioral Model of Manpower Decision making is developed and exercised. The simulation incorporates a weak statement of Parkinson's Law which claims that the demand for labor is partially dependent upon the number of employees already on board. Additional features include exponential forecasting and variable delays in hiring and firing. A central feature of the model is the existence of organizational slack which is defined as the number of people in excess of what is necessary to satisfy market demands.

(Cont'd)

Various sensitivity analyses are conducted and the Model's implications are discussed.

INTRODUCTION

The management of industrial manpower is undoubtedly one of the most complex and challenging responsibilities of modern corporations. While more literature and research pertaining to manpower management have become available in the last decade, (e.g., Ahamad and Blaug, 1973; Burack and Walker, 1971; Burack, 1972; Clough, Lewis, and Oliver, 1974; Mabry, 1973; Miner; 1974; Vetter, 1967) actual practice is largely characterized by intuition, tradition, crisis management, and occasionally heuristic problem solving. To be sure manpower management frequently incorporates methodology of a high degree of sophistication, as in the technology of forecasting (Ahamad and Blaug, 1973). However, it is the rare corporation that undertakes an intensive analysis of its manpower as a system. Firms tend to concentrate upon the size and quality of their labor forces, rather than examining the dynamics underlying changes in their manpower. Managers frequently view manpower as just another factor of production to be treated on the same economic basis as other forms of capital. However, manpower resources have particular properties that influence the manner in which they can and should be managed.

Specifically several behavioral aspects of manpower management should be considered, i.e., features concerning the decision making behavior of manpower managers. An important element of manpower decision is the sensitivity of the firm to market fluctuations. While some firms are highly responsive to economic change, others are more moderate in their behavior. Some choose to react quickly so as to exploit current opportunity; others move gradually hoping to ride through transient changes. These differences probably would be reflected in their manpower management. In addition to differing sensitivities to market conditions, firms also typically encounter delays in implementing manpower decisions, that is, changes in personnel do not usually happen instantaneously but over some period of time (Burack, 1972). What effect do such delays have on manpower levels?

Another characteristic is the existence of organizational slack, which is defined as excess resources beyond those required to satisfy market demands (Cyert and March, 1963). In the classical theory of the firm such slack would be zero in a perfectly competitive economy; realistically, there is usually some amount of slack, positive or negative, in most firms. Indeed Cyert and March (1963) suggested that slack is desirable because it encourages innovation and growth. One example of positive manpower slack would be under-employment, while one of negative slack might be large backlogs of production.

A final behavioral property of manpower is the amount of work performed within a firm as a function of external market demands and also of the number of people inside the firm. Typically planning of production manpower consists of forecasting future workload and then determining the appropriate amount of labor to support the forecasts (Burack, 1972; Lynch, 1972). In short the demand function is taken to be independent of the available manpower. While such a view may be appropriate for factory operations over short planning horizons, it may be less useful at the level of the total organization over long periods. For example consider the sales component of a modern corporation. The volume of revenue and number of customers are usually a function of the size of the sales force. Additionally consider research and development of engineering manpower. Future revenue is frequently dependent upon the number of personnel engaged in product innovation. In general the cause-effect relationship between economic demand and available manpower is not a simple linear one but probably mutually interactive. As observed by Parkinson in his famous law (1957), work expands to fill the time and people available to do it.

This paper presents a model that incorporates these behavioral features in an effort to simulate a rather simple manpower decision-making system and hopefully illustrates the utility of adopting a systems perspective of manpower and of developing models for analyzing the dynamics underlying changes in manpower. By exercising the model the consequences of these behavioral properties are derived and the implications for manpower management are assessed.

THE MODEL

The basic paradigm used in this model is that of Cyert and March (1963) and is a simplified adaptation of their duopoly model. In taking a behavioral approach to the problem, organizational size is assumed to be determined rationally and consciously by the firm's management. For example, Miller and Haire (1970) developed a micro-manpower model in which personnel flows into, through, and out of an organization were generated through the simulation of the decision outcomes of each individual manager in a firm. Patz (1969) used linear goal programming techniques to solve a similar problem of manpower flows in a stable military organization. In contrast, this paper has adopted a simpler approach assuming that manpower decisions are centrally determined with information that is complete except for knowledge of the manpower demand function.

The basic structure of the model is relatively simple. It ignores cost considerations, differentiated manpower, and organizational learning. The model hypothesizes that an organization will seek to control its organizational slack, which is defined as the number of personnel exceeding those necessary to accomplish a specified amount of work in a given period. The justification for keeping slack within given limits is that if there is excessive slack, the firm is operating inefficiently, while if there is insufficient slack the firm will lose opportunities to increase its performance level. The primary manpower decision involves the determination of additions and deletions of manpower based upon the slack that is estimated for the next period. If the estimated slack is more negative than a predetermined percentage of the current labor force then a decision to add more personnel is initiated. Conversely if estimated slack is greater than a given percentage, a reduction in personnel is initiated.

An important feature of the decisions is that they are not implemented immediately, since there are time delays associated with hiring and firing employees. Delays in hiring exist because suitable kinds and quantities of labor are not always available and recruiting activities typically consume substantial amounts of time. Delays in separating personnel are not quite as obvious for it is often assumed that employee separation is completely under management's control. However, in addition to any administrative delays in terminating personnel (e.g., two weeks notice) management may be constrained by loyalty and morale considerations or by its reluctance to lose the accumulated training and experience of its employees. Moreover, when faced with possible separation, most people will increase their search activities to find work that will justify their continued tenure (March and Simon, 1958, p. 99). Not only will vulnerable employees seek transfer opportunities, but they will also try to improve their own performance relative to their associates and thus forestall termination. Indeed this behavior constitutes an essential element of classical industrial motivation theory. Although such activity may not result in any real increase in output, it at least increases the difficulty in distinguishing legitimate performance from cosmetic busy-work. Delays in hiring and delays in firing need not be equal, and in fact are varied in exercising the model.

Another important element of the model is the nature of the workload demand function. In the initial model, the workload for a given period is a function of the manpower level of the previous period plus a sizeable random component. This relationship is tied to total work of an organization as related to the size of its membership. In essence this is a weak statement of Parkinson's Law, which claims that work will equal that amount which will keep the organization occupied. More accurately, the law states that organizations will be occupied with available work. This version of the model also recognizes the effect of externalities, through the random component, which represents exogenous market demands.

The last major component of the model consists of forecasting procedures. In this version, estimates of available manpower are generated without error, that is, they are perfectly accurate since attrition rates and manpower changes initiated in prior periods are known precisely. However, workload forecasts are much less accurate and are generated from exponential smoothing of past forecasts with the most recent observation of the workload demand. Effects of varying the smoothing parameter are examined in the sensitivity analysis. Forecasted workload, $F(T + 1)$ is given by $F(T + 1) = (1 - \alpha) F(T) + \alpha B(T)$ where $B(T)$ equals the actual workload in the current period. This equation shows that if $\alpha = 1$, the forecast is equal to the current actual workloads; hence the forecasts are extremely sensitive to external fluctuations. On the other hand, if $\alpha = 0$ forecasts depend only upon the very first forecast and is totally insensitive to change. Hence α is a measure of the model's sensitivity to external perturbations.

This model bears several similarities to inventory models in operations research (Wagner, 1969). Manpower can be thought of as an economic resource stocked to meet a variable demand function. There may be uncertainty in the supply as well as in the demand (Rand, 1965) and decision rules can be established to satisfy some objective function. There are differences, of which only two will be identified. First, manpower inventory is not consumable or depreciable in the conventional sense; it need not be replenished if positive slack exists for it is possible never to reorder for finite demand functions although there may be high holding costs. Second, the demand function is not independent of the available manpower, which is counter to a fundamental assumption in standard inventory problems.

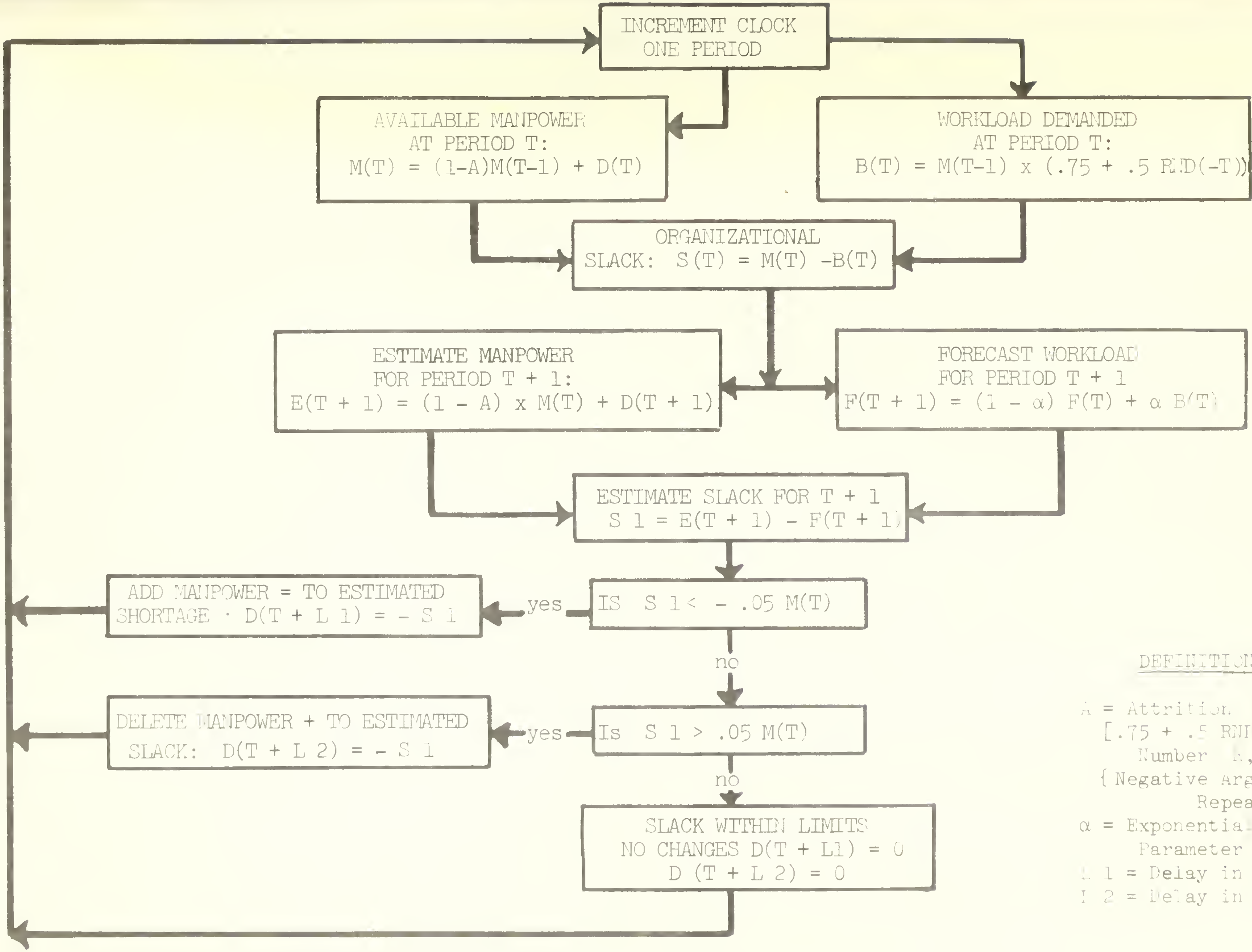
THE PROGRAM

Exhibit I shows the flowchart of the basic program. Initial values were set for all parameters and defined the standard case around which sensitivity tests were conducted. The values for the standard case are:

Available manpower for 1st period	= 1000
Workload demanded for 1st period	= 900
Slack for 1st period	= 100
Forecasted work for 1st period	= 1000
Delay in the arrival of new hires	= 1 period
Delay in leaving of fired employees	= 2 periods
Attrition rate per period	= 1%
Forecast smoothing parameter	= 0.1
Limits of acceptable slack	= ± 5%
Range of random variation	= ± 25%

Variations of the basic program were developed to generate the statistical and sensitivity analyses. The same sequence of random numbers was used in all runs to allow valid comparisons. No provisions have been made for including seasonality or secular trends, although such modifications are easily made.

The program is structured more or less sequentially in an attempt to achieve a block design to facilitate later extensions and revisions. Future elaborations will include more sophisticated forecasting methods, more complicated decision mechanisms (e.g., recognition of costs), and stochastic variation of manpower as well as workload.



DEFINITION [illegible]

A = Attrition [illegible] per [illegible]
[.75 + .5 RND [illegible] = [illegible]
Number [illegible]
{Negative Argument [illegible]
Repeatability}

α = Exponential [illegible]
Parameter

L 1 = Delay in [illegible] Manpower

L 2 = Delay in Divest[illegible] Manpower

EXHIBIT I: FLOWCHART OF MANPOWER CHANGE PROGRAM

THE RESULTS

The Standard Case

The results of running the model with the values in the Standard Case are shown in Exhibit II. The descending appearance of the manpower time series was not an intentional attempt to simulate contraction but probably a consequence of the sequence of machine generated random numbers. The time series of each of the four outputs show differing degrees of autocorrelation, as might have been expected from inspection of the model's equations. Since the manpower levels were derived from the workload estimates the estimates follow the manpower levels fairly closely. The actual work shows a variability typical of a partially random number. The average slack for the forty periods is quite low, but is dominated by the large standard deviation. This variability seems to be largely determined by the amount of randomness in the actual workload. Although the manpower stays within fairly reasonable limits, the slack output does not, despite the explicit attempt of the model to control slack. Slack clearly violates the acceptable limits of 5% most of the time.

Limits of Acceptable Slack (Bandwidth)

To assess the effects of these limits, the width of the range of acceptable slack was varied from .01 to .26 in steps of .05, so that the complete width of acceptable slack ranged from 2% to 52% of the current manpower level, Exhibit III. Again, manpower and forecasted workload were closely related as measured by the means and standard deviations. Not unexpectedly, the wider the range the greater the standard deviation as manpower is allowed to fluctuate more. However, both the mean and standard

EXHIBIT II

STANDARD CASE PROGRAM RUN

MNPWR5

PERIOD	MANPOWER	ACTUAL WORK	EST WORK	SLACK
1	1000	900	1000	100
2	990	863.787	990	126.213
3	980.1	900.169	977.379	79.9312
4	970.299	1180.76	969.658	-210.463
5	960.596	926.379	990.768	34.2166
6	950.99	840.724	984.329	110.266
7	941.48	713.443	969.968	228.037
8	932.065	1059.36	944.316	-127.298
9	922.745	932.262	955.821	-9.51733
10	913.517	1137.92	953.465	-224.398
11	971.91	841.062	971.91	130.848
12	962.191	1077.06	958.825	-114.866
13	952.569	765.601	970.648	186.967
14	943.043	936.552	950.143	6.49121
15	933.613	1104.01	948.784	-170.394
16	924.277	801.213	964.306	123.064
17	915.034	966.503	947.997	-51.4689
18	905.884	1084.23	949.848	-178.349
19	963.286	705.376	963.286	257.911
20	953.653	840.381	937.495	113.273
21	944.117	921.382	927.784	22.7347
22	934.676	1000.68	927.144	-66.0035
23	925.329	1078.3	934.497	-152.969
24	916.076	1154.26	948.877	-238.189
25	969.416	770.567	969.416	198.85
26	959.722	906.317	949.531	53.4048
27	950.125	987.228	945.21	-37.103
28	940.624	1066.43	949.411	-125.806
29	931.217	1143.95	961.113	-212.732
30	979.397	754.203	979.397	225.194
31	969.603	885.042	956.877	84.5608
32	959.907	967.092	949.694	-7.18518
33	950.308	1047.41	951.434	-97.1045
34	940.805	1124.7	961.032	-183.894
35	931.397	1157.55	977.398	-226.156
36	995.414	723.937	995.414	271.476
37	985.46	820.355	968.266	165.104
38	975.605	858.345	953.475	117.26
39	965.849	895.493	943.962	70.3557
40	956.191	931.812	939.115	24.3781
RUN AVERAGE	951.712	944.296	959.7	7.41595
STND DEV	23.3657	135.314	17.6408	149.341

EXHIBIT III

ANALYSIS OF BANDWIDTH (Each Run = 40 Periods)

	MANPOWER	ACTUAL WORK	EST WORK	SLACK
Q WIDTH = •01				
RUN AVERAGE	990•272	981•318	985•726	8•95399
STND DEV	17•7142	139•438	18•0115	146•376
Q WIDTH = •06				
RUN AVERAGE	910•275	904•98	936•295	5•29476
STND DEV	37•5415	133•49	31•2874	137•372
Q WIDTH = •11				
RUN AVERAGE	887•887	883•133	923•078	4•75323
STND DEV	50•1485	130•846	40•7121	131•981
Q WIDTH = •16				
RUN AVERAGE	842•002	838•739	895•931	3•26331
STND DEV	81•6753	139•827	67•7546	128•999
Q WIDTH = •21				
RUN AVERAGE	827•571	828•368	894•526	-•79678
STND DEV	95•8812	151•283	70•4262	123•3
Q WIDTH = •26				
RUN AVERAGE	827•571	828•368	894•526	-•79678
STND DEV	95•8812	151•283	70•4262	123•3

deviation of the slack output diminish significantly; the average slack becomes less than zero and the standard deviation is reduced by about 15 The obvious explanation that slack diminishes because the wider change permits more stable manpower is not consistent with the data since the manpower standard deviation increases. Furthermore, in contrast to Exhibit II, the standard deviation of the slack output is less than the standard deviation of the actual workload for the three highest values of bandwidth. Another inexplicable result is that all of the average run values decline with greater bandwidths. The redundancy of data for the two highest values of bandwidth are thought to be the result of the particular sequence of random numbers used in the simulation runs, i.e., no numbers were generated in the interval, .21 - .26, during the forty periods.

Time Lags in Termination and Acquisition

Analysis of the effect of delays in terminating and acquiring personnel produced two additional results (Exhibit IV). First, although increasing delays in termination were expected to generate growth in all outputs (because the longer it takes to get rid of people, the more people there are, the more slack there is, and the more work is found), increasing lags in acquisition had little effect on contraction. Except for the marked change in the transition from a one period lag to two periods, there is not much difference in the means and variances of the outputs for different acquisition delays. The second result is that decreasing the acquisition lag does not appear to accelerate growth as might be expected. In addition, average slack seems to decrease with quicker responses in hiring. In short both types of delay appear to effect the model in the same direction, although termination lags

EXHIBIT IV

ANALYSIS OF LAGS (Each Run = 40 Periods)

	MANPOWER	ACTUAL WORK	EST WORK	SLACK
TERMINATION LAG= 0				
RUN AVERAGE	951.712	944.296	959.7	7.41595
STND DEV	23.3657	135.314	17.6408	149.341
TERMINATION LAG= 1				
RUN AVERAGE	928.109	922.323	946.765	5.78619
STND DEV	26.1331	133.875	22.9799	136.654
TERMINATION LAG= 2				
RUN AVERAGE	959.714	951.477	967.599	8.23746
STND DEV	27.9553	132.075	14.9237	140.442
TERMINATION LAG= 3				
RUN AVERAGE	945.163	938.807	956.879	6.35703
STND DEV	22.8561	138.057	18.9224	148.435
TERMINATION LAG= 4				
RUN AVERAGE	1059.83	1045.09	1018.4	14.7354
STND DEV	87.9688	164.19	59.0219	154.304
TERMINATION LAG= 5				
RUN AVERAGE	1031.92	1018.98	1003.55	12.9381
STND DEV	68.7479	153.829	45.428	151.798
TERMINATION LAG= 6				
RUN AVERAGE	1094.52	1078.97	1041.33	15.5448
STND DEV	102.941	182.445	74.2207	167.837

	MANPOWER	ACTUAL WORK	EST WORK	SLACK
ACQUISITION LAG = 0				
RUN AVERAGE	827.571	828.368	894.526	-.79678
STND DEV	95.8812	151.283	70.4262	123.3
ACQUISITION LAG = 1				
RUN AVERAGE	827.571	828.368	894.526	-.79678
STND DEV	95.8812	151.283	70.4262	123.3
ACQUISITION LAG = 2				
RUN AVERAGE	939.779	933.278	952.803	6.50177
STND DEV	23.9685	137.763	20.1564	142.4
ACQUISITION LAG = 3				
RUN AVERAGE	933.293	928.805	950.151	4.48772
STND DEV	36.8288	146.929	21.6832	153.262
ACQUISITION LAG = 4				
RUN AVERAGE	927.526	922.206	946.659	5.31946
STND DEV	32.3778	144.825	23.7017	138.904
ACQUISITION LAG = 5				
RUN AVERAGE	936.09	927.521	951.787	8.56955
STND DEV	36.7237	135.268	21.1078	139.231
ACQUISITION LAG = 6				
RUN AVERAGE	928.308	922.512	945.208	5.79564
STND DEV	42.2719	138.293	23.5283	147.561

seem to have a slightly stronger influence.

Exponential Smoothing Parameter

Exhibit V shows the very strong effects of the smoothing parameter. As the value of the parameter approaches unity, the standard deviations grow dramatically. In the case of the manpower output, the standard deviation has increased by almost three orders of magnitude, while the standard deviation of the slack output increased by a factor of twenty. Of more interest is the behavior of the means. Exhibit VI illustrates the overwhelming relationship between growth and the forecasting parameter. The effect would be even more striking if the actual time series were plotted instead of just the averages. Exhibit VII represents an abbreviated time series with the smoothing coefficient set equal to 0.9. The tremendous growth is also reflected in the slack output. It was not intuitively obvious that slack would become so strongly positive with highly sensitive forecasting parameters.

Initial Conditions

In order to check the dependence of the model on initial conditions, the actual workload for the first period was varied from 50% to 150% of the standard case value (Exhibit VIII). The model was fairly insensitive to such variation. Upon reconsideration, the cause was due to the nature of the workload demand function which is more sensitive to initial manpower than initial workload. Varying the workload for the first period merely introduces small transients that are substantially damped by the model in subsequent periods. In a sense this is a manifestation of Parkinson's Law in that people generate their own work functions with little regard to external demands.

EXHIBIT

SENSITIVITY ANALYSIS OF SMOOTHING PARAMETER ([illegible])

	MANPOWER	ACTUAL WORK	EST WORK	SLACK
SMOOTHING PARAMETER = 0				
RUN AVERAGE	980.199	973.46	1000	6.73857
STND DEV	13.9316	146.16	0	151.109
SMOOTHING PARAMETER = .1				
RUN AVERAGE	946.003	939.189	958.042	6.81356
STND DEV	23.6245	133.897	18.7936	137.237
SMOOTHING PARAMETER = .2				
RUN AVERAGE	1002.6	991.76	989.917	10.8411
STND DEV	48.4342	146.149	42.7972	156.994
SMOOTHING PARAMETER = .3				
RUN AVERAGE	1152.66	1136.34	1121.58	16.3196
STND DEV	113.643	195.314	130.031	163.636
SMOOTHING PARAMETER = .4				
RUN AVERAGE	1328.9	1300.16	1264.79	28.738
STND DEV	235.891	291.443	233.451	225.84
SMOOTHING PARAMETER = .5				
RUN AVERAGE	1435.82	1400.99	1363.67	34.8282
STND DEV	318.422	362.241	321.347	220.737
SMOOTHING PARAMETER = .6				
RUN AVERAGE	1978.12	1912.95	1838.76	65.1639
STND DEV	683.907	721.39	680.724	329.56
SMOOTHING PARAMETER = .7				
RUN AVERAGE	3359.01	3188.98	3007.08	170.023
STND DEV	1901.27	1863.73	1783.34	598.943
SMOOTHING PARAMETER = .8				
RUN AVERAGE	3916.45	3748.85	3578.96	167.602
STND DEV	2002.11	2047.74	2006.74	703.735
SMOOTHING PARAMETER = .9				
RUN AVERAGE	7399.49	6805.25	6338.93	594.234
STND DEV	5736.6	5245.08	4959.24	1588.58
SMOOTHING PARAMETER = 1				
RUN AVERAGE	13897.7	12594.2	11685.9	1303.5
STND DEV	12773.2	11550.3	10983.8	3266.46

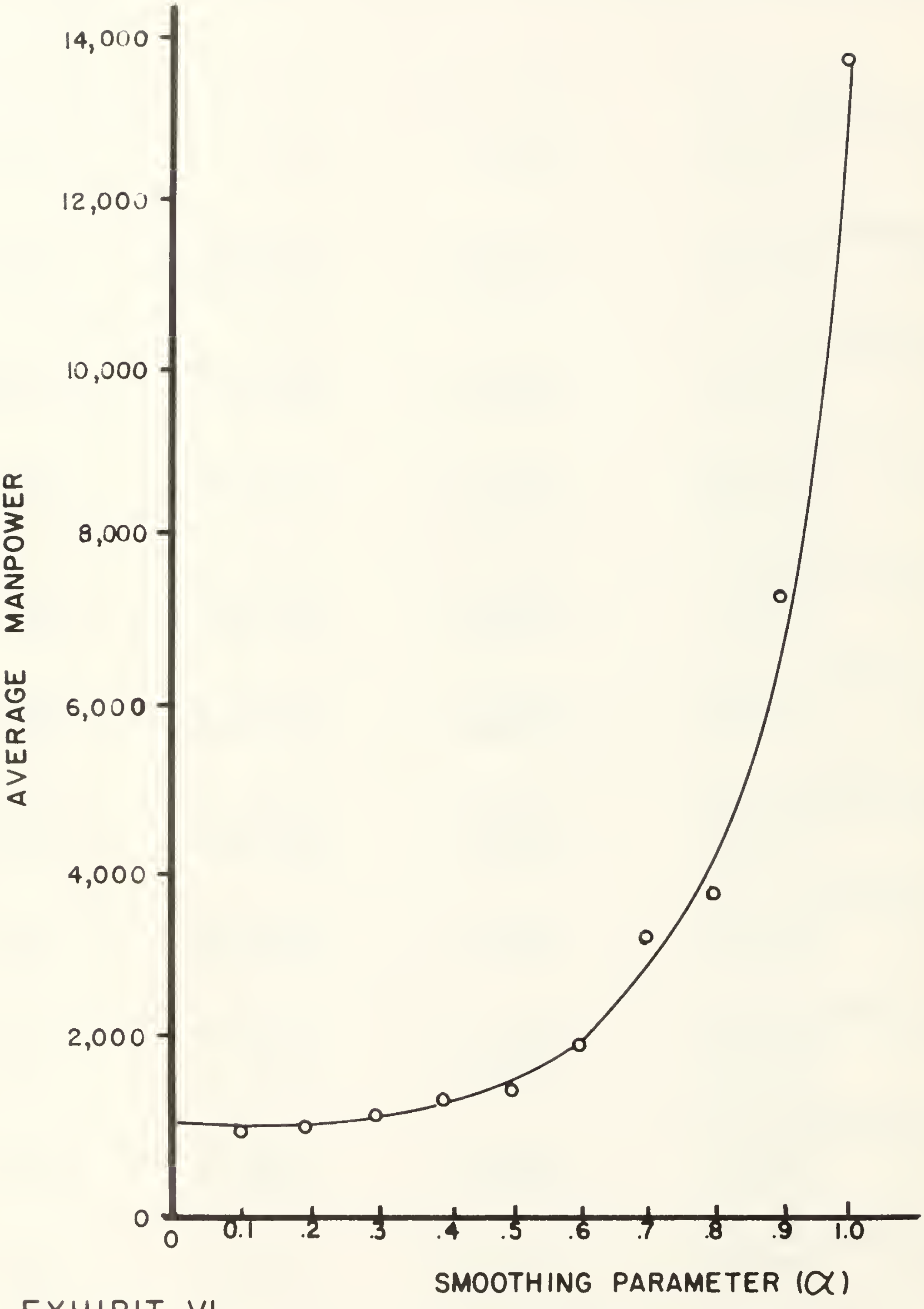


EXHIBIT VI

AVERAGE MANPOWER AS A FUNCTION OF α

EXHIBIT VII

ABBREVIATED RUN WITH α = 0.9 (41 Periods)

PERIOD	MANPOWER	ACTUAL WORK	EST WORK	SLACK
1	1000	900	1000	100
6	1213.43	1072.74	946.96	140.[illegible]
11	2630.92	1659.25	2152.31	971.66[illegible]
16	4939.75	4282.04	4197.9	557.707
21	6590.3	5473.84	4889.87	1116.46
26	9956.55	9402.51	6914.29	554.043
31	14970.2	13664.6	12588.5	1305.55
36	21914.2	13941.	21914.2	797[illegible]
41	27648.8	28253.1	23440.	-604.2[illegible]
RUN AVERAGE	9061.47	8283.26	7659.76	795.2[illegible]
STND DEV	7749.46	7012.37	6590.12	2088.55

EXHIBIT VIII

VARIATION OF INITIAL WORKLOAD

	MANPOWER	ACTUAL WORK	EST WORK	SLACK
INITIAL ACTUAL WORK = 500				
RUN AVERAGE	940.688	923.668	942.662	7.02037
STND DEV	24.7247	149.827	16.7748	147.334
INITIAL ACTUAL WORK = 600				
RUN AVERAGE	921.099	908.092	934.875	5.50645
STND DEV	28.631	142.18	20.8362	135.745
INITIAL ACTUAL WORK = 700				
RUN AVERAGE	948.457	935.622	955.173	7.83592
STND DEV	27.6825	135.474	15.2677	138.699
INITIAL ACTUAL WORK = 800				
RUN AVERAGE	943.082	934.295	953.092	6.28662
STND DEV	22.937	139.211	18.2354	147.995
INITIAL ACTUAL WORK = 900				
RUN AVERAGE	961.583	954.107	970.086	7.47492
STND DEV	25.5743	134.426	14.8925	139.105
INITIAL ACTUAL WORK = 1000				
RUN AVERAGE	968.882	963.305	974.109	8.07669
STND DEV	29.2906	138.495	15.9879	150.806
INITIAL ACTUAL WORK = 1100				
RUN AVERAGE	953.995	951.65	967.247	7.34544
STND DEV	27.192	136.175	20.4883	137.759
INITIAL ACTUAL WORK = 1200				
RUN AVERAGE	979.074	978.435	987.583	8.14004
STND DEV	20.8194	143.883	15.7098	153.075
INITIAL ACTUAL WORK = 1300				
RUN AVERAGE	977.698	980.314	990.062	7.38383
STND DEV	25.6569	151.412	18.5314	146.528
INITIAL ACTUAL WORK = 1400				
RUN AVERAGE	1003.29	1006.54	1012.32	9.2426
STND DEV	28.3339	154.275	15.8664	150.713
INITIAL ACTUAL WORK = 1500				
RUN AVERAGE	1002.54	1009.47	1013.47	8.0711
STND DEV	21.3852	166.107	17.8998	157.631

CONCLUSIONS

In summary, this model of a manpower decision making system exhibits the following characteristics.

A. Keeping organizational slack within narrow limits is not easily accomplished with simple decision rules.

B. Increasing delays in termination of personnel is associated with modest growth in manpower and in organizational slack.

C. Increasing delays in the acquisition of personnel does not have substantial impact on growth or slack.

D. Forecasting that is highly sensitive to current workload results in very rapid growth in manpower and organizational slack.

E. Varying the initial workload has little effect on changes in manpower and slack.

While not appropriate as general conclusions, the following suggestions should be considered:

1. Firms that are highly receptive to external perturbations may experience rapid growth in manpower and organizational slack. For example, aerospace companies respond quickly to large contracts, but also have difficulty in controlling costs. In other words, highly reactive firms may become bigger and simultaneously less efficient in manpower utilization over time.

2. Tighter control over the termination of personnel may have stronger impact on growth and efficiency than over the acquisition of personnel.

3. In addition to management's decisions on manning levels changes in manpower may be influenced by powerful forces such as organizational slack, market sensitivity, and implementation delays.

Although the interpretation of these results may not be definitive, the value of adopting an analytic approach to manpower as a system is hopefully reinforced. What would be of great use to manpower planners and managers is understanding the dynamics and constraints that govern the labor forces in their own organizations. Examination of the internal mechanisms by which corporations are managed may yield significant insights about the nature of manpower changes. Various decision rules, personnel practices, management policies, and even institutional traditions may have substantial influence over variations in the size and mix of labor. For example, seniority clauses in labor contracts and equal opportunity requirements often constitute severe constraints on management's ability to hire and fire. Such factors can be evaluated explicitly and the impact of changes in policy assessed using formal methods of analysis. With the aid of systems analysis, simulation, and decision modeling, management can begin to refine the intuition and judgement that is applied to manpower planning and control.

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